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NOR.WEB DPL LIMITED [/]; (). BROWN, Paul, Anthony [/]; (). DICKINSON, John [/]; (). BROWN, Paul, Anthony [/]; (). DICKINSON, John [/]; (). HACKNEY, Nigel, J. ; ().

Published

(54) **Title: SIGNAL COUPLER**
(54) **Titre: COUPLEUR DE SIGNAUX**

(57) Abstract

The present invention relates to apparatus for coupling communications equipment to a conductor or cable. In particular, it relates to an "elbow" or "T" shaped type coupler. The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energised, distribution or transmission network. In a first aspect, the present invention provides a coupler including a pin (1, 20) for electrical connection to a socket, high pass filter means (5) electrically connected to the pin and connection means (7) for connecting the high pass filter means to a signal source. Preferably the pin (1, 20) is adapted or arranged so as to be suitable for connection to a socket (e.g. a primary terminal) of a transformer. In this way, a high frequency communication signal coupling may be made to the primary winding of the transformer without any need to interrupt the operation of the transformer or the power supply to consumers. Furthermore, the installation of the connection is safe and easy to do, which as will be appreciated, is important in high voltage equipment.

(57) Abrégé

L'invention concerne un appareil destiné à coupler un équipement de communications à un conducteur ou un câble. Notamment, cette invention concerne un coupleur en forme de "coude" ou de "T", et a pour objectif de présenter un procédé et un appareil destinés à coupler de manière efficace des signaux de communication à un réseau de transmission ou de distribution existant, éventuellement excité, et à les déconnecter dudit réseau. Selon un premier aspect, cette invention a trait à un coupleur comprenant une broche (1, 20) à connecter électriquement à une douille, un dispositif de filtrage passe-haut (5) connecté électriquement à la broche, et un dispositif de connexion (7) permettant de connecter le dispositif de filtrage passe-haut à la source de signaux. De préférence, la broche (1, 20) est conçue ou disposée de manière à être adaptée à la connexion à une douille (par ex., un terminal primaire) d'un transformateur. Ainsi, on peut effectuer un couplage de signaux de communication de haute fréquence à un bobinage primaire du transformateur, sans avoir besoin d'interrompre le fonctionnement du transformateur ou l'alimentation en courant des consommateurs. En outre, l'installation de la connexion est sûre et facile à faire, ce qui est appréciable, d'autant plus qu'elle est importante dans les équipements à haute tension.

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(71) Applicant *(for all designated States except US)*: NOR.WEB DPL LIMITED [GB/GB]; Regus Building, 268 Bath Road, Slough SL1 4DX (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: BROWN, Paul, Anthony [GB/GB]; 30 Applerigg, Kendal, Cumbria LA9 6EA (GB). DICKINSON, John [GB/GB]; 47 Brooklands Road, Burnley, Lancashire BB11 3PR (GB).

(74) Agents: HACKNEY, Nigel, J. et al.; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).

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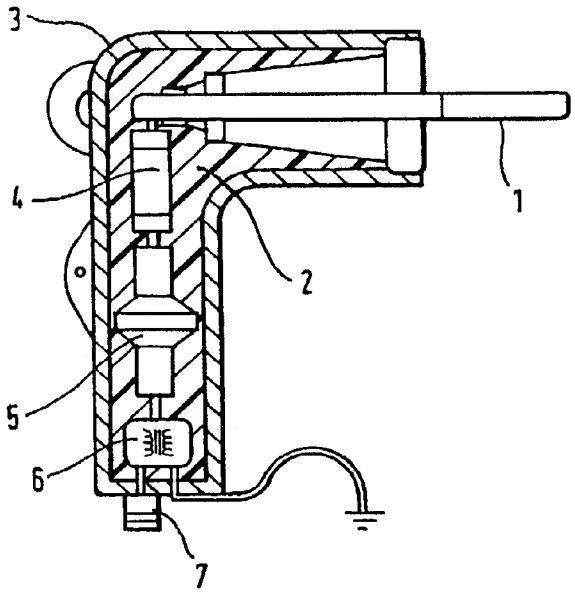
The present invention relates to apparatus for coupling communications equipment to a conductor or cable. In particular, it relates to an "elbow" or "T" shaped type coupler. The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energised, distribution or transmission network. In a first aspect, the present invention provides a coupler including a pin (1, 20) for electrical connection to a socket, high pass filter means (5) electrically connected to the pin and connection means (7) for connecting the high pass filter means to a signal source. Preferably the pin (1, 20) is adapted or arranged so as to be suitable for connection to a socket (e.g. a primary terminal) of a transformer. In this way, a high frequency communication signal coupling may be made to the primary winding of the transformer without any need to interrupt the operation of the transformer or the power supply to consumers. Furthermore, the installation of the connection is safe and easy to do, which as will be appreciated, is important in high voltage equipment.



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Description

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SIGNAL COUPLER

The present invention relates to apparatus for coupling communications equipment to a conductor or cable. In particular, it relates to an "elbow" or "T" shaped type coupler.

Various published patent applications of the present applicant disclose systems whereby telecommunications signals can be conveyed along an electricity distribution and/or transmission network. These applications include the following; WO94/09572, WO95/29536, WO95/29537, WO96/07245, WO98/19398, the disclosures of which are incorporated herein by reference.

In order to safely, efficiently and cost effectively couple communication signals onto power distribution and/or transmission networks it becomes desirable to consider not only the interconnecting device itself, and its component parts (e.g. a high pass filter), but also the ease with which such a device might be retro-fitted to an existing energised power distribution and/or transmission network. This becomes a more complex issue as the distribution and/or transmission network voltage

increases. Furthermore, the actual location of such interface devices requires to be carefully considered in order to permit other associated functions, such as transformer by-pass, to be safely and cost effectively implemented as necessary.

In some electricity distribution/transmission networks it is desirable to provide a communications signal bypass path so that the communication signal can be routed around the transformer, as a transformer may act as an attenuator for high frequency signals.

In, for example, the USA it is common for pad (ground) mounted transformers to be used in electricity distribution and transmission networks. The primary windings of such transformers are often connected in a ring and, for this purpose, each transformer is usually provided with two primary winding connection terminals or sockets - in figure 4 these are labelled H1a and H1b. The intention is that a high voltage cable may be connected to, for example, terminal H1a and then if a further connection onto another pad mount transformer is required, such connection can be made via a further lead connected to terminal H1b. Obviously if no further connection is required then nothing will be connected to

terminal H1b.

The high voltage connections to terminals H1a and H1b are usually made by means of an elbow connector, as shown in figure 6. The connector consists of a resin filled elbow shaped package 60 protruding from one end of which is a probe or pin 62. This probe 62 locates inside socket H1a (for example) when connected to a transformer. Probe 62 is electrically connected via a connection 64 to a terminal 66. Terminal 66 is connected to a high voltage cable or conductor when in use.

The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energised, distribution or transmission network.

Accordingly, in a first aspect, the present invention provides a coupler including a pin for electrical connection to a socket, high pass filter means electrically connected to the pin and connection means for connecting the high pass filter means to a signal source. Preferably the pin is adapted or arranged so as to be suitable for connection to a socket (e.g. a primary terminal) of a transformer.

Such a connector is suitable for use in situations where, for example, terminal H1b as described above is not otherwise in use. In this way, a high frequency communication signal coupling may be made to the primary winding of the transformer without any need to interrupt the operation of the transformer or the power supply to consumers. Furthermore, the installation of the connection is safe and easy to do, which as will be appreciated, is important in high voltage equipment.

However, as was explained above, the terminal H1b (for example) may not always be free and will not be free if a number of transformers have been connected in a ring or a line.

Accordingly, in a second aspect, the present invention provides a coupler including: a pin for electrical connection to a socket, a second socket electrically connected to the pin and being adapted for receipt of a second pin of a further (e.g. high/medium voltage, low frequency) connector, high pass filter means electrically connected to the pin and connection means connected to the high pass filter means for receipt of a signal from a signal source.

In this way, the connector may be formed in a "T" shaped package and can be interposed between a regular low voltage connector (e.g. an elbow shaped connector as shown in figure 6) and the input socket of, for example, a transformer. Again, this allows the coupling of communications equipment to the low voltage line in a safe and efficient manner. In particular, if a number of transformers are connected in a ring as described above, then this allows one of the connectors (e.g. attached to terminal H1b as described above) to be disconnected without any interruption to the consumers' electricity supply and for the "T" shaped connector then to be connected safely.

Preferably the coupler of either of the above aspects is arranged in a standard "elbow" or "T" shaped configuration so as to fit standard sockets on transformers. Preferably the coupler also includes a fuse which may be located between the high pass filter means and the pin. The high pass filter means may be provided by a capacitor and also included may be a protective balun and/or isolation transformer. The whole connector package may be filled with a suitable insulative resin and/or oil or other suitable insulative medium, preferably with adequate stress relief

capabilities.

In a further aspect, the present invention provides a method of coupling a communication signal to an electricity network and/or bypassing a transformer of the network using the apparatus as described above. A signal cable may be coupled to the signal source connector of the coupler which in turn may be connected to an amplifier and/or signal regenerator (could be analogue or digital) and/or modem device, and/or remodulator. This in turn may be connected to a further low voltage coupler which is then connected to one or more of the terminals of the secondary of the transformer.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:-

Figure 1 shows a coupler according to a first embodiment of the present invention.

Figure 2 shows a coupler according to a second embodiment of the present invention.

Figure 3 is a schematic circuit diagram of the coupler

according to an embodiment of the present invention.

Figure 4 shows a typical pad mount transformer with couplers according to embodiments of the present invention being used.

Figure 5 is a schematic diagram of a bypass system for a transformer according to an embodiment of the present invention.

Figure 6 is a schematic diagram of a prior art low voltage coupler.

Figure 1 shows a coupler according to the first embodiment of the present invention. The coupler is included in a typical elbow connector profile package such as might be obtained from Elastimold (TM), for example their 160 series. Such connectors are utilised, particularly in the USA, to connect underground single phase medium voltage (e.g. 13.8kv) distributor cables to the primary connections of a pad mount transformer such as that shown in figure 4.

The coupler includes a medium voltage probe 1 encased in a housing 3 which has been filled with an insulative

resin 2 and/or stress relieving rubber. The probe 1 is connected to a fuse 4 which in turn is connected to a medium voltage capacitor (e.g. 0.01 microfarads) which acts as a high pass filter for the communication signals. The capacitor 5 is connected to a balun and/or isolation transformer 6 which provides a protective coupling for high frequency communication signals. The transformer 6 is in turn connected to a connector 7 which may, in use, be connected to a signal source (not shown).

As is explained above, such a coupler may be used to couple to an unused primary winding terminal (e.g. H1b in figure 4) of a pad mount transformer.

Figure 2 shows a coupler according to a second embodiment of the present invention. The coupler includes a pin 20 which, as for the embodiment of figure 1, is dimensioned so as to fit into a standard high voltage socket of e.g. a pad mount transformer as shown in figure 4. The pin 20 is again connected to a fuse 21, capacitor 22, balun/isolation transformer 23 and connected 24 in the same way as the embodiment of figure 1. However, the difference lies in the inclusion of a pin socket 25 which is electrically connected to pin 20 and is in line with pin 20 in the upper arm of the "T" shaped coupler package. Socket 25 is dimensioned so as to receive a pin

(which will be similar dimensions to pin 20) from a standard low voltage coupler such as that shown in figure 6.

In this way, a prior art coupler such as shown in figure 6 can be "piggy-backed" onto the coupler of figure 2 which in turn is connected to a socket of a transformer.

This permits the coupler of figure 2 to be connected to transformers such as that shown in figure 4 where both terminals H1a and H1b are already in use.

A schematic diagram of the electrical circuit of the couplers of figures 1 and 2 is shown in figure 3. A fuse link 30 is shown connected respectively to a transformer bus bar 31 and a capacitor 32. As before, the capacitor 32 is connected to a balun and/or isolation transformer (or other suitable transformer) 33, one winding of which is connected to a signal source 34. The secondary winding of the balun transformer terminates in a suitable high frequency connector (e.g. a BNC connector) and a safety earth bonding strap 35 is also provided.

Figure 4 illustrates a pad mount transformer as utilised in a typical North American underground power

distribution network. The transformer includes primary winding terminals H1a and H1b and also secondary winding terminals X1, X2 and X3. A medium voltage high frequency coupler (such as the embodiment of figure 1) 40 is connected to terminal H1b and from the coupler 40 a connection 42 may be made to high frequency communication signal apparatus. Also shown are a number of earth connections 44 for the various couplers and also for the secondary winding socket X2.

Figure 5 is a schematic diagram of a transformer bypass which could be used with, for example, the transformer of figure 4. A "T" shaped connector 50, such as that of the embodiment of figure 2, is "piggy-backed" with a normal low voltage connector 52 and both of these are connected to a primary winding terminal H1a. Communication signals may be propagated along the cable or conductor 51 as has been described in previous published patent applications by the present applicant.

The communication signals may be removed from cable 51 using coupler 50 and then passed through an optional amplifier or signal regenerator 53. The signals can then be passed to a low voltage coupler 54 which in turn connects the signals to one or more of the secondary

winding terminals X1, X2 and X3. The signals are then propagated on the low voltage network (LV).

As will be appreciated, the above embodiments are given by way of example only and modifications will be apparent to those skilled in the art.

Claims

CLAIMS

1. A coupler including a pin for electrical connection to a socket, the pin being adapted or arranged so as to be suitable for connection to a socket of a transformer, high pass filter means electrically connected to the pin and connection means for connecting the high pass filer means to a signal source.

2. A coupler according to claim 1 including a second socket electrically connected to the pin and being adapted for receipt of a second pin of a further connector.

3. A coupler according to claim 1 or claim 2 arranged in a standard "elbow" or "T" shaped configuration.

4. A coupler according to any of the above claims including a fuse located between the high pass filter means and the pin.

5. A coupler according to any one of the above claims wherein the high pass filter means includes a capacitor.

6. A coupler according to any one of the above claims

including a protective balun and/or isolation transformer.

7. A method of coupling a communication signal to an electricity network and/or bypassing a transformer of the network using the apparatus of any of the above claims.

8. A method according to claim 7 in which the high frequency communication signal coupling is made to the primary winding of the transformer without any interruption in the operation of the transformer or the power supply to consumers.

9. A method according to claim 7 or claim 8 wherein, if a number of transformers are connected in a ring one of the connectors is disconnected.

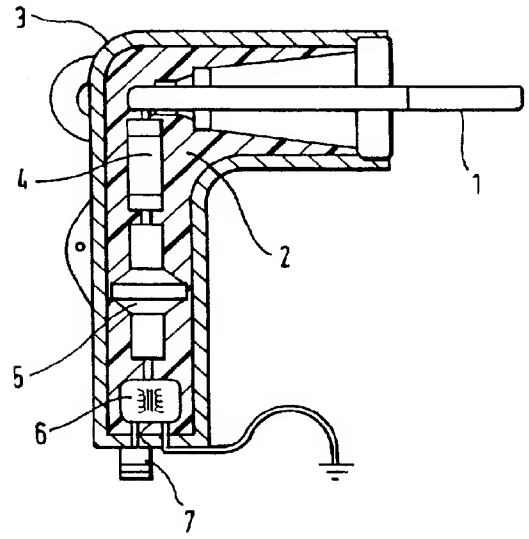


FIG.1.

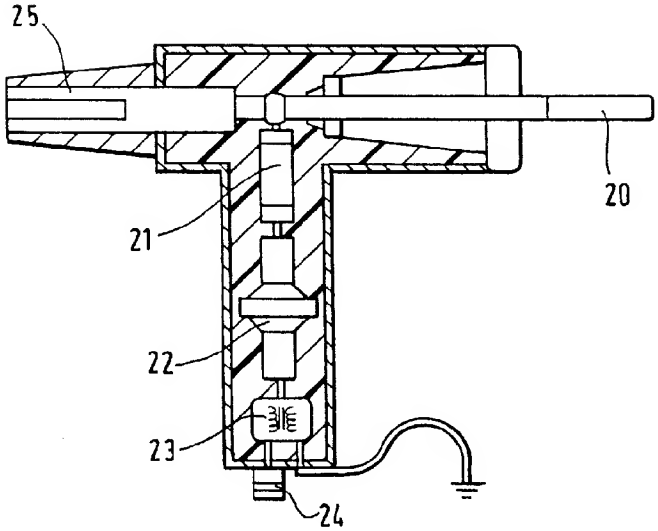
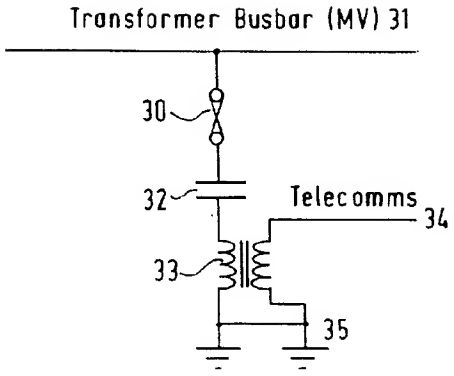


FIG.2.


Transformer Busbar (MV) 31
30
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Telecomms
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33
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FIG.3.

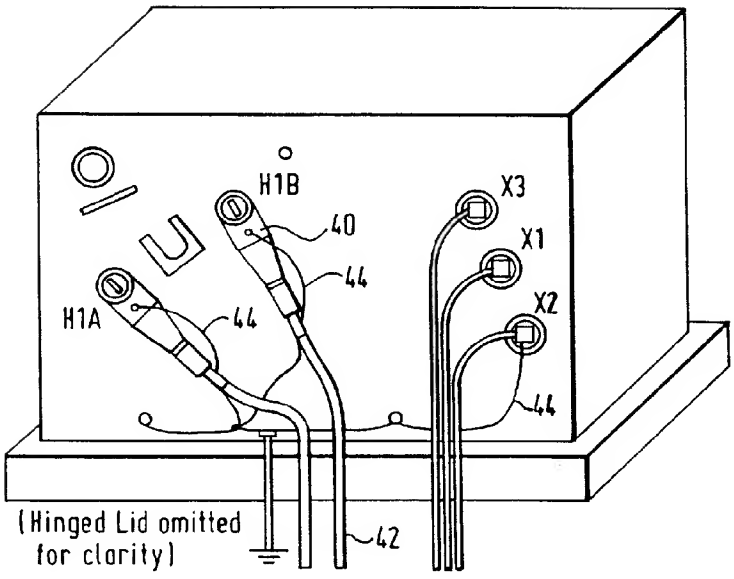

H1B
40
44
X3
X1
X2
H1A
44
44
(Hinged Lid omitted for clarity)
42

FIG.4.

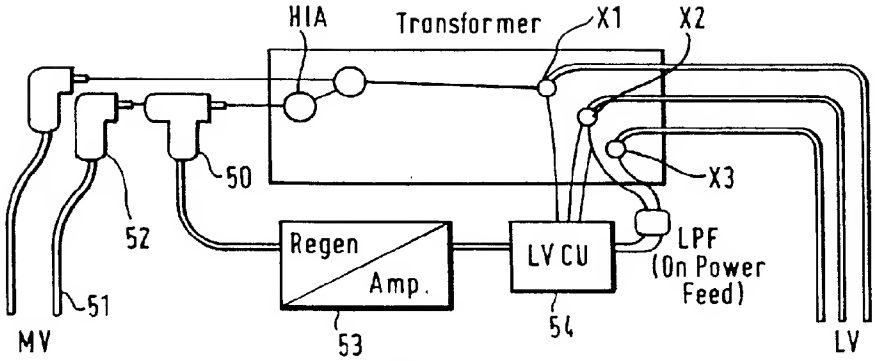
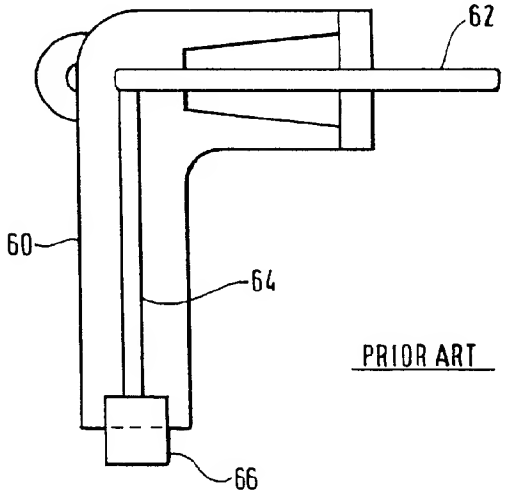

HIA
Transformer
X1
X2
X3
50
52
51
MV
Regen
Amp.
53
LV CU
54
LPF
(On Power
Feed)
LV

Fig.5.


62
60
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PRIOR ART

Fig.6.

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/GB 00/01146

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R13/53 H01R13/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 192 231 A (DOLIN, JR.) 9 March 1993 (1993-03-09) column 2, line 67 -column 3, line 45; figures 1-3	1,7
A	US 4 904 932 A (SCHWEITZER , JR.) 27 February 1990 (1990-02-27) column 4, line 10 -column 5, line 6; figure 1	1,7
A	WO 96 32763 A (LAVERICK, ROBERT) 17 October 1996 (1996-10-17)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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